

CLAIMS

1. A method of receiving data, the method comprising the steps of:
inserting a symbol having a higher modulation level on a symbol
5 basis into a transmission burst formed at transmission; and
transmitting the transmission burst including the symbol
inserted in the inserting step;
2. A method of receiving data, the method comprising the steps of:
10 receiving data transmitted on a burst signal basis; and
detecting a symbol in response to a symbol position where the
symbol having a higher modulation level and being inserted in the burst signal
received in the receiving step is placed, and in response to a symbol position
where a symbol other than the foregoing symbol is placed.
15
3. A transmission device of a communication system that carries out
communication on a burst basis by digital modulation, the transmission device
comprising:
a data stream dividing means for dividing transmission data at a
20 given ratio;
a first quadrature vector mapping means for providing a first
divided data with a signal space diagram according to a first modulation
method;
a second quadrature vector mapping means for providing a
25 second divided data with a signal space diagram according to a second
modulation method having a higher modulation level than the first modulation
method; and

a multiplexing means for placing a symbol modulated by the first modulation method and a symbol modulated by the second modulation method at given places respectively, then multiplexing a transmission burst.

5 4. A reception device of a communication system that carries out communication on a burst basis by digital modulation, the reception device comprising:

a reception process means for receiving a communication signal, then outputting a burst signal of the signal received;

10 a dividing means for dividing the burst signal received in response to given places;

a first symbol detecting means for providing a first divided signal with symbol detection in response to a first modulation method;

15 a second symbol detecting means for providing a second divided signal with symbol detection in response to a second modulation method having a higher modulation level than the first modulation method; and

a data stream multiplexing means for placing a result detected by the first symbol detecting means and a result detected by the second symbol detecting means in a given order, and multiplexing a reception data stream.

20

5. The method of transmitting data as defined in claim 1, wherein when communication quality is different at each symbol position in the burst, a place where the symbol having a higher modulation level is inserted or a place where a symbol modulated by a second modulation method having a higher modulation level is inserted is assigned to a symbol position of which communication quality is considered in advance better than other symbol positions.

25

6. The method of receiving data as defined in claim 2, wherein when communication quality is different at each symbol position in the burst, a place where the symbol having a higher modulation level is inserted or a place where
5 a symbol modulated by a second modulation method having a higher modulation level is inserted is assigned to a symbol position of which communication quality is considered in advance better than other symbol positions.

10 7. The transmission device as defined in claim 3 further comprising:
a communication quality information obtaining means for obtaining information about whether or not communication quality is different at each symbol position in the burst; and

an insertion place detecting means for assigning, based on the
15 information about difference in the communication quality, one of a place where the symbol having a higher modulation level is inserted and a place where a symbol modulated by a second modulation method to a symbol position of which communication quality is better than other symbol positions.

20 8. The reception device as defined in claim 4 further comprising:
a communication quality measuring means for measuring communication quality at each symbol position in the burst;

a communication quality information notifying means for notifying a transmission device of information about the communication quality
25 measured by the communication quality measuring means; and

an insertion place information obtaining means for obtaining information about a place where a symbol having a higher modulation level is

inserted.

9. A communication system comprising:

a reception device including:

5 a reception quality measuring means for measuring reception quality at each symbol position in a burst received; and

a reception quality information notifying means for notifying a transmission device of information about reception quality measured by the reception quality measuring means, and

10 the transmission device including:

a communication quality information obtaining means for obtaining the information about the reception quality notified by the reception device; and

15 an insertion place detecting means for assigning, based on the reception quality information, an insertion place to a symbol position of which communication quality is better than another symbol position.

10. The transmission device as defined in claim 3, wherein when the transmission device re-transmits, following a request signal of re-transmission, a part of redundant data of a burst already transmitted, the transmission device further comprises a means for superposing the partial redundant data to be re-transmitted to a position of a symbol having a higher modulation level.

11. The transmission device as defined in claim 10 further comprising:

25 an error correction coding means for correcting an error of a transmission data stream, outputting a coded data stream, and outputting a redundant section deleted at the coding through another channel;

a memory means for storing temporarily the section deleted; and
a re-transmission control means for supplying data of the
redundant section stored to the second quadrature vector mapping means for
superposing the re-transmitted partial data.

5

12. The method of transmitting data as defined in claim 1, wherein in
the step of inserting a symbol having a higher modulation level, known bit data
is inserted in a part of the symbol having a higher modulation level, so that a
signal space diagram at a modulation is limited.

10

13. The method of receiving data as defined in claim 2 further
comprising the step of:

estimating reception quality of a signal received by using a vector
of the signal received at a symbol position of a higher modulation level, which
vector is inserted on a symbol basis in a part of a burst.

15

14. The reception device as defined in claim 4 further comprising a
reception quality estimating means for estimating communication quality by
limiting a placement of signal points with insertion of known bit data in a part of
bits, and by using a vector of a reception signal at a symbol position undergone a
signal space diagram by the second modulation method.

20

15. The transmission device as defined in claim 3, wherein a signal
space diagram of a symbol having a higher modulation level or a symbol
undergone a signal space diagram by the second modulation method is placed
away by a given Euclidean distance in response to an amplitude of a symbol
undergone a signal space diagram by the first modulation method.

25

16. The reception device as defined in claim 4, wherein a signal space diagram of a symbol having a higher modulation level or a symbol undergone a signal space diagram by the second modulation method is placed away by a
5 given Euclidean distance in response to an amplitude of a symbol undergone a signal space diagram by the first modulation method, and the second symbol detecting means detects the symbol placed as discussed above.

17. The transmission device as defined in claim 3 further comprising:
10 a transmission packet generating means for generating and outputting transmission data on a packet basis based on a process in a higher layer, and also generating a transmission packet which outputs information about a size of the packet; and
a transmission control means for detecting a quantity and an
15 insertion place of a symbol having a higher modulation level based on the information about a size of the transmission packet and information about a size of a burst in a physical layer, and for controlling a data separation by the data stream dividing means and a content of the burst generated by the multiplexing means based on information about a determined quantity and a determined
20 insertion place about the symbol.

18. The transmission device as defined in claim 17, wherein the transmission control means controls the multiplexing means such that the information about the packet size is inserted in the transmission burst.
25

19. The method of transmitting data as defined in claim 1 further comprising the steps of:

generating and outputting transmission data on a packet basis based on a process in a higher layer, and also generating a transmission packet which outputs information about a size of the packet; and

controlling transmission for detecting a quantity and an
5 insertion place of a symbol having a higher modulation level based on the information about a size of the transmission packet and information about a size of a burst in a physical layer, and controlling a data separation in a data stream dividing step for dividing a data stream based on information about a determined quantity and a determined insertion place about the symbol, and
10 also controlling a content of the burst generated in a multiplexing step which generates a transmission burst.

20. The method of transmitting data as defined in claim 19, wherein the transmission control step controls the multiplexing step such that the
15 information about the packet size is inserted in the transmission burst.

21. The reception device as defined in claim 4, wherein data to be received is generated in a higher layer on a packet basis, and the reception device further comprises:

20 a reception control means for controlling a data separation by the dividing means and a content of the burst generated by the data stream multiplexing means based on information about a size of a transmission packet; and

a reception packet generating means for reconstructing packet
25 data in the higher layer transmitted by using data of each reception burst supplied from the data stream multiplexing means.

22. The reception device as defined in claim 21, wherein the information about a size of a transmission packet is inserted in the reception burst, and a reception control means extracts a size of the transmission packet inserted in the burst.

5

23. The method of receiving data as defined in claim 2, wherein data to be received is generated in a higher layer on a packet basis, and the method further comprises the steps of:

reception controlling for controlling a data separation in a
10 dividing step and a content of the burst generated in a data stream multiplexing step based on information about a size of a transmission packet; and

generating a reception packet for reconstructing packet data in the higher layer transmitted by using data of each reception burst supplied from the data stream multiplexing step.

15

24. The method of receiving data as defined in claim 23, wherein the information about a size of a transmission packet is inserted in the reception burst, and the reception controlling step extracts the size of the transmission packet inserted in the burst.

20